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ABSTRACT

Eleven experts in mathematics education, special education, and assessment completed an open-ended survey on current math instruction in relation to the "Curriculum and Evaluation Standards" of the National Council of Teachers of Mathematics and the perceived appropriateness and feasibility of the standards for students with disabilities. In general, the experts agreed that adoption of the Standards has been minimal and that math education in practice continues to emphasize basic skills. Two opposing viewpoints were evident in the experts' responses. One viewpoint was that the Standards did not recognize the importance of individual differences and were not better than current practice in math education. The opposing viewpoint was that the Standards reflected a vision of what mathematics should be and that minimal, nonsubstantial modifications were needed for students with disabilities. Possibilities are presented for bridging the gap between: (1) recommendations for meeting the needs of students with mathematics learning problems and other handicaps, and (2) the current status of the Standards. (Contains 21 references.) (Author/JDD)

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Technical Report 3

Experts' Opinions on National Math Standards for Students with Disabilities

National Center on Educational Outcomes

The College of Education
UNIVERSITY OF MINNESOTA

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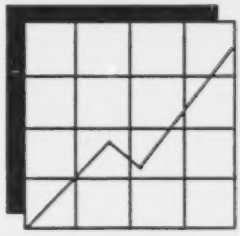
Technical Report 3



Experts' Opinions on National Math Standards for Students with Disabilities

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Abstract

Eleven experts in mathematics education, special education, and assessment completed a survey on current math instruction in relation to the Curriculum and Evaluation Standards of the National Council of Teachers of Mathematics (open-ended format), and the perceived appropriateness and feasibility of the **Standards** for students with disabilities (rating scale). Responses to the open-ended questions are summarized in this paper. In general, the experts agreed that adoption of the **Standards** has been minimal and that math education in practice continues to emphasize basic skills. Two opposing viewpoints were evident in the experts' responses. One viewpoint was that the **Standards** did not recognize the importance of individual differences and were not better than current practice in math education. The opposing viewpoint was that the **Standards** reflected a vision of what mathematics should be and that minimal, non-substantial modifications were needed for students with disabilities. These opinions are summarized and discussed.

Experts' Opinions on National Math Standards for Students with Disabilities

> In the absence of well-defined and demanding standards, education in the United States has gravitated toward de facto national minimum expectations, with curriculas focusing on low-level reading and arithmetic skills and on small amount of factual material in other content areas. (National Council on Education Standards and Testing, 1992, p. i)

The topic of standards for school and pupil performance has dominated much of the discussion in the educational community during the past few years. For example, it is difficult to pick up an issue of Educational Leadership without finding at least a couple of articles on standards or reform. The program for the 1992 annual meeting of the American Educational Research Association listed no less than 50 sessions on the related topics of reform, school reform, and restructuring. ("Standards" was not an indexed descriptor.) The Association for Supervision and Curriculum Development (Willis, 1992) reported that states are scrambling to respond to reform issues in general, and that 34 states have specific efforts underway to "redefine" their curriculum guidelines for mathematics in response to the Curriculum and Evaluation Standards (the *Standards*) published by the National Council of Teachers of Mathematics (1989).

The Office of Technology Assessment (1992) defined the term "standards" in two ways in its report Testing in American Schools: Asking the Right Questions.

> In the more general context [standards] denotes goals, desirable behaviors, or models to which students, teachers, or schools should aspire. Such standards describe what optimal performance looks like and what is desirable for students to know. For example, the National Council of Teachers of Mathematics has determined that a standard for mathematics instruction is to emphasize mathematics as problem solving. The word standards, in its more technical meaning, denotes the specific levels of proficiency that students are expected to attain. Thus, setting a passing score for a test is equivalent to setting a standard of performance on that test. (p. 3)

The first meaning provided by the Office of Technology Assessment is the focus of this paper.

Standards and standard setting are being discussed by those who support the concepts and most of the activities they have sparked, and by those who take a far less favorable view of the enterprise in its current form. On the one side are advocates who believe that there is great merit in raising standards and setting national educational goals (e.g., Boyer, 1991; Bruininks,

Thurlow, & Ysseldyke, 1992). On the other side are authors who warn of an "elitist" mentality and the possibility of "academic child abuse" in light of the proposition of inappropriate standards that are (a) too broad, (b) unattainable or unreasonable, (c) for preferred practice and not outcomes, and/or (d) over specified (e.g., Bateman *(more authors)*, 1992). One point is clear -- whether or not one agrees with setting, redefining, or implementing standards, everyone involved in the educational system will be affected by the activities surrounding standards. Local, state, and national efforts are increasing daily, and the popularity of the idea of reshaping most educational disciplines within a standards framework continues to grow.

But, will everyone who is affected by reforms and standards be involved in the decision making that changes the system? This question has been raised by both general and special educators. Even though most position papers and calls for standards by policy groups, legislatures, and government agencies contain language that is inclusive of all students, few of their activities and actions follow through on the inclusion rhetoric. Anderson (1992) suggested that most, if not all, current reform oriented activities are geared toward 90% of American school students, because they do not consider students who are exceptional. In his view, the 10% of the school population with disabilities is simply overlooked in most reform activities.

Expressing the concerns of the National Association of State Boards of Education (NASBE), Roach (1992) contended that because of reform and standards setting an "unparalleled opportunity" exists for state boards to create an environment that encourages meaningful instruction for all students. The opportunity exists now because previous reform-oriented activities were narrowly focused and "fostered the growth of a separate system for serving children with special needs" (p. 3). She is careful to point out, however, that inclusive classrooms are not always associated with the most "effective" teaching, as typically defined by states and local districts. Among teachers judged to be competent educators, instructional efforts typically focus more on the higher achieving students than on the lower achieving students, perhaps because an increase in the performance of the higher achieving students raises the class average on assessments used in measuring progress toward established standards. This kind of

bias potentially creates a perceived need to raise standards for some students, while placing less importance on the educational needs of those who do not fit into the existing system.

Recently, the work of the National Council on Education Standards and Testing (NCEST) was the topic of testimony provided by the Council for Exceptional Children (CEC) to the House Subcommittee on Elementary, Secondary and Vocational Education. The issue of including all students in performance standards was emphasized, because it is not clear how NCEST intends to have a "scale of student performance standards." CEC encouraged further study of the inclusion issue by all groups because the setting of standards is arbitrary, and although many "professional organizations and groups are involved in the setting of standards, there is no policy which requires these groups to set standards which will challenge the most able students as well as those with special learning needs" (Council for Exceptional Children, 1992, p. 2).

The purpose of this paper is to begin this type of inquiry -- to evaluate the extent to which established standards address the needs of students with disabilities. The *Standards*, published by the National Council of Teachers of Mathematics (1989), represent a well-developed set of nationally recognized standards for student performance. They are referenced often as a model for future standard-setting activities, and have been embraced as the de facto yardstick for measuring the effectiveness of reform efforts in mathematics by state and local boards of education (Hanley, 1992). The *Standards* were derived from knowledgeable opinion (T. Romberg, personal communication, February 12, 1992) through a systematic review and revision process. Experts from the mathematics community were consulted by the lead writing team, but no explicit effort was made to solicit input relevant to exceptional children, including those students considered to have disabilities.

Our survey of experts was developed to address the question of applicability of the *Standards* to the educational needs of students receiving special education services. Areas of inquiry for the experts matched those covered by the *Standards* themselves:

(a) content coverage
(b) instructional presentation
(c) assessment and evaluation

In the *Standards* document, teachers and other educators were invited to expand and enrich mathematics instruction and evaluation "for gifted or handicapped students who need and deserve special attention" (National Council of Teachers of Mathematics, 1989, p. 253). Through this survey, we hoped to fill in some of these informational gaps.

Method

Subjects

Experts in the areas of mathematics education, special education, and assessment were nominated by representatives of professional associations in special education and math education -- the Council for Exceptional Children (CEC), the National Association of State Directors of Special Education (NASDSE), the National Council of Teachers of Mathematics (NCTM), and the Office of Special Education Programs (OSEP). A total of 22 persons were nominated. Selection of potential respondents (15 of the 22) was done by the staff of the National Center on Educational Outcomes (NCEO). Each potential expert was contacted and provided an explanation of the purpose, rationale and requirements of the survey. Those persons agreeing to serve as respondents were offered a token honorarium.

Twelve people agreed to serve as respondents, however, one person later withdrew from participation. All respondents were university faculty members. Two respondents specialized in mathematics education, while five special education experts were involved in mathematics education for students with disabilities. Six experts were working with school-age students (grades K-12). Table 1 is a descriptive matrix of the experts' levels and areas of specialization.

Materials

An initial draft of the questionnaire was developed by the NCEO staff in February of 1992 and reviewed by Math Education faculty. The final version of the survey had two main response formats. Open-ended questions were used to address current practices for instruction,

assessment, and evaluation of math education programs. Also covered were the experts' views of the *Standards* in relation to disability categories and level of disability severity. Rating scales were used to gauge perceived appropriateness and feasibility of the *Standards* for students with disabilities. Rating scale items are not discussed in this paper. (A copy of the entire survey is in Appendix A.)

Procedures

In April 1992, questionnaires were mailed to the 12 respondents, with stamped return envelopes enclosed. A follow-up letter and second copy of the questionnaire were mailed five weeks later to the respondents who had not responded to the first mailing. The final contact efforts were made by telephone at the end of June. Responses were obtained by the end of July from 11 of the 12 persons to whom the survey was sent. Respondents were asked to indicate in writing whether they would allow their answers to be quoted. Two respondents did not grant permission for identification.

Two project staff members reviewed responses to the open-ended questions and clustered general response themes into several categories using procedures described by Bogdan and Biklen (1992). The objective of this sorting procedure was to reach consensus on the nature and

Table 1

Respondents' specialization and grade level interest (n=11)

Grade	Special Education (No Math Specialization)	Special Education (Math Specialization)	Math Education
K-12	3	1	2
K-8		3	
5-8		1	
K-6	1		

content of the responses. Reviewers were allowed to "argue for" key points they found in individual responses. In a second review, response clusters were changed to reflect agreed upon categories.

Results

For ease in reporting the survey results, we list the questions given to the respondents and then list selected comments that illustrate representative opinions. The identified affiliations of the respondents are those given at the time the surveys were completed.

Eight of eleven respondents indicated that they were very familiar with the NCTM *Standards*. Three special education experts without mathematics specialization indicated that they were aware of the NCTM *Standards* but had not read or discussed them in depth.

In your opinion, how have the NCTM *Standards* been received by various groups (e.g., state education agencies, professional organizations, and policy groups)? Comment, if you can, on whether the NCTM *Standards* are being adopted, modified, rejected, or ignored.

Nine persons responded to this question. All agreed that, generally, the NCTM *Standards* have been well received by administrative units, state agencies, and professional organizations.

> The NCTM *Standards* have been favorably received by almost all professional organizations and, not surprisingly, by Presidential candidates such as Clinton and Tsongas. I don't know of any professional organization that has rejected or questioned the educational, social, or empirical validity of the NCTM *Standards*. My assessment is that the *Standards* are widely adopted as noted on pages vi-vii of the Curriculum and Evaluation *Standards*. (Edward Kameenui, University of Oregon)

> Certainly State Educational agencies that deal specifically with mathematics are aware of the *Standards*. Similarly State professional organizations such as the Association of Mathematics Teachers of New York State (AMTNYS) have been including both awareness sessions and discussions of the *Standards* in their state conferences. (Pat Tinto, Syracuse University)

> I think that state agencies are taking the *Standards* quite seriously. I have seen on several occasions where the *Standards* are being used as a filter for reviewing mathematics materials. Also textbooks publishers are using the *Standards* as a guide as they revise their materials. (Ted Hasselbring, Vanderbilt University)

Some of the respondents made distinctions among acceptance, awareness, and communication of the *Standards* with respect to different levels of the educational system. Although many organizational and administrative groups have embraced the *Standards*, classroom teachers in both general and special education are seen as having less awareness and/or more difficulty regarding them in comparison to other groups. Special Education as a separate entity was also seen as less well informed. Examples of these views include:

> I doubt you could find a mathematics educator who would not indicate some support or level of adoption of the *Standards*. The problem is that the *Standards* are not getting to the classroom except for a surface level commitment to problem solving. That is, the interpretation of a dominant force in mathematics education commits itself to the *Standards* as being implemented within a broad base constructivist theme. This theme has not been translated to the classrooms. I doubt that 5 percent of special educators have given more than scant attention to the *Standards* and a major difficulty in making adaptations to them are that special educators, including the college faculty, do not know math and are in conflict with respect to a high commitment to computation as the basis of math programs for students with disabilities. (John Cawley, State University of New York at Buffalo).
>
> The *Standards* are accepted as the primary set of goals for math education. Although they are being adopted, there seems to be few avenues suggested to achieve them. (George Brent, Glassboro State University).
>
> In my opinion the NCTM *Standards* have been embraced by all levels (above the classroom) of the professional mathematics community. It is my experience that most classroom teachers with whom I speak are unaware of the *Standards* and their content. Unfortunately, it is my impression that the special education community seems to be unaware of the content and intent of the *Standards*. (Brian Enright, University of North Carolina at Charlotte)
>
> The leadership group of the local organization of mathematics teachers is very aware of the *Standards*, but it is doubtful that their membership holds that same degree of awareness. (Pat Tinto, Syracuse University)

The NCTM *Standards* contain recommendations for both the desired curriculum/content coverage and the instructional methods to be used in mathematics education. Please describe the degree of correspondence you see between current math education programs for students with disabilities and the *Standards*.

Nine of eleven experts stressed that there is low correspondence between current math education programs for students with disabilities and the NCTM *Standards*. Clearly, the major reason for the low correspondence is the emphasis on computation and basic skills in most math classes. Special education classes are seen as even more likely to stress drill and practice.

> I do not know of any math education programs for students with disabilities. What exits is generally a watered-down representation of elementary school mathematics. Validation of this can be found by examining any special education methods text and looking at what is contained therein. For the most part, all of this is contradictory to the *Standards*. When students receive their math in regular classes and are supported or not supported by special educators, the emphasis is on computation at every grade level. (John Cawley, SUNY at Buffalo)

> I see little congruence. I believe that special education programs are far too focused on basic/remedial memorization. The "competency-based" movement has contributed to this mechanization and notions that "developmental sequences" are appropriate/adequate. There has been no curriculum in special education. (Luanna Meyer, Syracuse University)

> I think there is very little correspondence between the curriculum/content coverage of math programs for students with disabilities and the *Standards*. In special education programs there is much more emphasis on procedural knowledge and computation than is suggested in the *Standards*. Special education teachers will have to change the content and the instructional procedures drastically to come into line with the *Standards*. (Ted Hasselbring, Vanderbilt University)

One expert questioned the implications of the priorities set by the *Standards* for the math education of students with disabilities.

> The primary focus of the *Standards* (K-4, 5-8, 9-12) is on problem solving, which is nominally defined as a "process" that is highly interactive (i.e., students share their thinking), collaborative and requires substantial amount of instructional time. This focus creates fundamental problems for students with disabilities in general education classrooms who need to be taught strategically, which requires teaching the most essential skills in the limited time allocated. Highly interactive, collaborative processes are not likely to increase the probability that students with disabilities will be taught strategically (i.e., teaching only essential skills, teaching big idea, teaching strategies that link critical concepts and algorithms). In fact, the "process" approach to problem solving is likely to lead to less teacher-directed and task engaged time. (Edward Kameenui, University of Oregon)

However, some experts asserted that the degree of correspondence would vary according to the service delivery models or grade levels.

> In most part in resource rooms or closed classrooms I see a heavy emphasis on arithmetic with little work beyond 8th grade mathematics. The content tends to emphasize algorithms. In inclusive settings the program varies more in that the students with disabilities are exposed to the same ideas as the other children in the room. Thus, their mathematics program is not different but the support each student must have does vary. (Pat Tinto, Syracuse University)

> (Answer relative to mild disabilities only) K-8 is reasonable. 9-12 could be, in parts, if instruction were radically improved. (a special education professor)

On the other hand, two experts did not address this question directly, citing the lack of an applicable knowledge base and/or validation studies. For example:

> I have no information on this. The *Standards* are only in the early stages of being implemented in the regular classrooms, and thus it will be a while before the *Standards* can be shown to be a productive way of teaching math in the regular classroom. There may need to be more evidence that they are effective in the regular classroom before special education teachers are willing to use the *Standards*. (a math education professor)

In the area of instructional methods, eight of eleven respondents noted the minimal correspondence. Yet, there were two different perspectives. Some experts, in line with the *Standards*, pointed out the current problematic nature of math education programs for students with disabilities.

> Given present day goings on, I see no relationships between what the *Standards* desire and what is going on with respect to instructional procedures in special education. A major discrepancy exists between what the direct instruction people describe as a theory and science of instruction and what the mathematics educators propose from a philosophy of instruction (i.e., constructivism). . . . For example, the direct instruction and curriculum-based types tend to seek nothing more than the answers to computation items in their work. The direct instruction types are critical of manipulatives and of the time taken with them. Yet, our own work is dependent on manipulatives. Why? Because they give paper-pencil outcome measures and we give manipulative outcome measures. (John Cawley, SUNY at Buffalo)

> The *Standards* stress the use of manipulatives as an initial method of instruction. Special education math does seem to use manipulatives, but it seems often mostly for counting. (Brian Enright, University of North Carolina-Charlotte)

> Again, poor congruence. The tutorial resource room model has little relevance to problem-solving skill development. Special education has institutionalized a dependence upon the special education teacher as the source of learning -- this needs to shift to innovations in regular education such as cooperative learning. (Luanna Meyer, Syracuse University)

> In classes for students with disabilities and in integrated settings there continues to be an overuse of worksheets, seatwork, and workbooks in the teaching and learning of mathematics. Rarely do I observe teacher-pupil interactions in quantitative problem solving or integrated lessons requiring the use of number operations. (Stanley Vitello, Rutgers-The State University of New Jersey)

Other respondents asserted that the low correspondence is caused by the inappropriateness of the *Standards*.

> [The *Standards* are] not data-based, and thus inappropriate. (a professor of special education).

> The instructional practices that appear to have gained the most prominence in the recent NCTM *Standards* are the discovery approaches and the use of . . . manipulatives. Many of the specific recommendations within the *Standards* revolve around the discovery method of initial instruction. For example, in one activity, the teacher sorts quadrilaterals into groups of parallelograms and non-parallelograms and ". . . has the children discover the teacher's rule for sorting the shapes" (p. 24). Teaching through discovery is more time-consuming than teaching through exposition. By definition, students with disabilities are "behind" their nondisabled peers academically and a logical requirement of "catching up" is efficient instruction. Increasing the use of manipulative materials as an instructional practice also has significant implications for students with disabilities. The use of manipulatives require substantial amounts of instructional time. Moreover, the general strategy for using manipulatives is simply inefficient and sets low performers up for frustration and failure. While manipulatives can be an important tool to make mathematics more meaningful to students, uncritical use should be discouraged. (Edward Kameenui, University of Oregon)

Three experts did not respond to this question, citing a lack of relevant information or insufficient knowledge on this issue.

What changes do you see happening in the future math education of students with disabilities as a result of the *Standards* for (a) curriculum/content coverage and (b) instructional methods?

Ten of the experts who responded to the question expected changes in math education for students with disabilities as a result of the *Standards* for curriculum and content coverage. Most of them saw the *Standards* as a guideline for the coming changes.

> One important aspect of the *Standards* is that it provides a coherent vision of what math education should be in a manner that each district and teacher can draw upon to improve student learning, and it's a shared vision by much of the math education community. I think this will reduce the likelihood that we will be subject to sudden shifts in how to teach math or what's important to learn. This should bring some stability to our focus on effective methods. (a professor of mathematics education)

> Problem solving and the integration of real life mathematics must come to be integral to math education/special students. Also in North Carolina advanced courses such as Algebra are now required. (Brian Enright, University of North Carolina-Charlotte)

> Hopefully the same changes as for non-disabled students. The *Standards* recommend changes in content and emphasis in mathematics programs for <u>all</u> children. The recommended changes promote conceptual understanding and a broader view of mathematics. The *Standards* also do away with the notion that mastery of computational skills is a prerequisite for learning other mathematical ideas. This is a powerful idea. It should break down the emphasis on arithmetic algorithms. It will also allow students to begin to work on mathematical problems even though they may be dependent on using a calculator for some of the computations. The *Standards* also put more emphasis on developing spatial sense, working with patterns, and using alternative strategies for problem solving.

> This opens up the mathematics content area for all students and should give those who have not been successful in the highly verbal mathematics of the past a chance to succeed. (Pat Tinto, Syracuse University)

> Students with disabilities should be required to follow the scope and sequences of mathematical learning, as outlined in the *Standards*, commensurate with their intellectual capacity and career goals. (Stanlely Vitello, Rutgers-The State University of New Jersey)

Some of the experts identified the conditions necessary for the change in special education.

> I am not sure that I expect most special education teachers to change the curriculum/content coverage unless a significant amount of professional development is provided. It is unrealistic to expect teachers to change what they are doing without significant development activities. Although commercial publishers will develop materials for special education students, materials alone will not suffice, teachers must receive instruction on how these materials should be used. (Ted Hasselbring, Vanderbilt University)

> My preference would be to restructure special education around the four process components of the *Standards* and to arrive at new conceptualizations of goals and the outcomes for these. (John Cawley, SUNY at Buffalo)

> Maybe very little [change] that is significant unless there is more interaction between the *Standards* writers (and program & text authors) and special educators. Such collaboration would enable the resulting math programs to provide advice or curriculum adaptation so students with various special needs won't simply be shifted to a different set of math materials organized by grade level (e.g., how to analyze the instructional tasks/steps more finely; which content has priority over other content when teachers must choose, etc.). (Martha Snell, University of Virginia)

Nine out of ten respondents expected changes in instructional methods. Those changes included more manipulatives, diversity, and new concepts in teaching.

> . . . less paper and pencil and more activities/discovery. (a special education professor)

> [Collaboration between special educators and text publishers] could yield a broader array of teaching approaches, and . . . have the potential of steering clear of label-approaches or teaching formula (e.g., the MR method) and focusing instruction on assessment of an individual's performance, knowledge, errors, etc. (Martha Snell, University of Virginia)

> With proper retraining special teachers will move more to the proper use of manipulatives, calculators, and probably computers. But this should reinforce a "thinking based" curriculum. (Brian Enright, University of North Carolina-Charlotte)

> I'd hope to see the same changes as for non-disabled students: that is breaking away from teaching, as telling and the isolation of the learner, to more use of

> cooperative groups doing mathematical investigations. I would like to see more acceptance of using appropriate tools for many tasks whether it is a calculator for doing computations or a computer to quickly graph equations for a unit investigating transformations. There may be other teaching/learning variables that need adjusting for students with special needs when this type of teaching occurs. Time becomes more of an issue when students are asked to think mathematically and make conjectures. Some lessons may still be teacher directed or make use of direct instruction but the instruction would consist of well chosen questions that promote mathematical thinking rather than the telling of routines and procedures. (Pat Tinto, Syracuse University)

> This is more problematic. Teachers can learn to follow prescription about the use of instructional aids and strategies to teach a particular lesson but this is not sufficient. Good mathematics teaching requires an understanding and appreciation of the structure of mathematics as well as the use of learning theories to generate instructional dyads to promote learning (e.g., Piaget, Skinner). (Stanley Vitello, Rutgers-The State University of New Jersey)

> More flexibility in teaching-learning opportunities, with support for heterogeneous student groupings where teachers and students work together to foster growth and learning. Encouragement of diverse instructional strategies to better meet the needs of different learners. (Luanna Meyer, Syracuse University)

Likewise in curriculum and content, some experts strongly asserted the prerequisites for the change in instructional methods such as inservice training or collaboration between regular and special education. Said one expert:

> Teachers will not alter their instructional procedures until they receive instruction on how procedures need to be changed. (Ted Hasselbring, Vanderbilt University)

Finally, one respondent was less confident about future instructional change.

> I doubt there will be large scale changes. What is sought in the *Standards* is at variance with the training, research and activities of instruction in special education. Of course, there may not be any significant changes in regular education either, but if there are, how will two teachers working with the same student resolve the discrepancy? (John Cawley, SUNY at Buffalo)

What are the implications of using traditional paper and pencil assessments (typically standardized tests of some kind) to appraise the performance of students with disabilities on the NCTM *Standards*? Please comment on this issue with respect to different disability categories and degrees of disability severity.

Three of the ten who responded to this question supported, with some reservations, paper and pencil assessments to appraise the performance of students with disabilities.

> The *Standards* are only appropriate for [the] mild population, with various disabilities. There are many problems with performance and portfolio assessments. . . . "Anchor" studies, correlating traditional assessments, to these new assessments are necessary to determine relative advantages and disadvantages. (a special education professor)

> Of course, pencil and paper assessments are appropriate if they are used correctly. And they should be a component of a total assessment system (Section 504 of Rehabilitation Act). Disability law and good instructional practices require that accommodations be made in the assessment of students with different disability categories (e.g., students with sensory disabilities, emotional disturbances). Generally speaking, mathematical assessment should be more enactive and iconic in the early years and become more symbolic. Assessment should be validated with demonstration in application. I would prefer to see the development of a multifaceted, multidimensional system of assessment, curriculum-based rather than the over-reliance on a national assessment in mathematics. (Stanley Vitello, Rutgers-The State University of New Jersey)

> The implication of using paper and pencil assessments to appraise the performance of students with disabilities on the NCTM *Standards* are no different than for students without disabilities. I think that for many skills, paper and pencil assessments work fine. However, many of the skills and knowledge that are part of the *Standards* do not lend themselves to paper and pencil testing for students whether they have disabilities or not. Alternative forms of assessment must be considered if we are serious about the way that mathematics is presented and if we are to understand what students really understand about math. (Ted Hasselbring, Vanderbilt University)

Seven experts soundly denounced the traditional paper and pencil assessments such as standardized tests in math education, in part because of limited coverage and accommodations.

> Clearly inappropriate, whether students are unlabeled ("typical") or labeled. Unless we finally acknowledge the limitations of traditional assessments, our "adoption" of new *Standards* will be at "lip service" level only. (Luanna Meyer, Syracuse University)

> Children with disabilities are entitled to test modifications to by-pass difficulties in accessing or responding during assessment. These modifications are the responsibility of the special educator. They, for the most part, give only paper pencil tests themselves, but modify them by reading the items to the kid. This is not an alternative. Even our so-called diagnostic tests (KEY MATH) are woefully inadequate and do not truly adjust for mathematics. (John Cawley, SUNY at Buffalo)

> Typically poor to disastrous. Such an approach also conflicts some with the Standard's philosophy for "typical" learners as it calls for multiple means of assessment. For students who have clear difficulty with a written mode for presenting problems the usual paper-pencil math tests underestimate their abilities. While this curriculum may yield better grasp of the content, the paper-pencil test may not give the true results and an assessment which employed manipulatives or back-forth exchange might be better. This is especially true for students with more severe cognitive disabilities. (Martha Snell, University of Virginia)

> The implications of using traditional paper-pencil assessments to appraise the performance of students with mild/moderate (academic) disabilities on the NCTM *Standards* are fairly obvious. In general, the use of traditional assessments does not argue well for these students for several reasons:

a. Content mismatch between what is taught in commercial programs and what is tested;
b. Fundamental difficulties in accurately assessing "production" type of problem solving process responses;
c. Fundamental problems with developing valid, sensitive assessments of higher order thinking skills in mathematics;
d. The absence of "intermediate" measures to use in the interim during which time the new generation of instructionally-sensitive, curriculum-based measures are being developed. (Edward Kameenui, University of Oregon)

Assessment must match the task for all students. Thus I see problems for all students that may be heightened for students with disabilities when traditional paper and pencil tests are used to assess tasks in which manipulatives may have been used, or for tasks for which tools such as calculators and computers were used. I cannot comment with respect to different disability categories and degrees of severity. I'm not sure how this would influence my response. Certainly, the ability to transfer (under a given time constraint) what has been learned using manipulatives to paper and pencil items is more severe for some children depending on the disability and the amount of available support. But more important would be the question of what are we assessing when we use traditional instruments to assess tasks learned in another context? (Pat Tinto, Syracuse University)

To what extent would the use of alternative procedures such as performance or portfolio assessments affect the feasibility of including students with disabilities in appraisals of performance relative to the NCTM *Standards*? Please comment on this issue with respect to different disability categories and degrees of disability severity.

Eight out of ten respondents viewed an alternative assessment approach in a favorable way. They believed that these "new" assessment procedures can be a viable alternative to the traditional assessments.

Obviously portfolio assessment and aspects of the authentic assessment movement address more complex and divergent "knowledge"- these parallel movements in assessment are essential to progress in applying and using the new approaches represented by the *Standards*. Further, teachers are empowered and excited about portfolio measures -- as are kids. Finally, such measures are ideally suited for individualized understanding and performance in heterogeneous groupings of students. (Luanna Meyer, Syracuse University)

Alternative approaches for assessment that do not emphasize learning weakness of a student and that are more consistent with the teaching methods used are likely to be more accurate. The same attention, however, given to devising better (more accurate) assessments of performance relative to the *Standards* needs to be given to instructional approaches. Teachers might be given guidelines of putting students (with disabilities or "at risk for failure") through a teaching-testing cycle to explore effective teaching approaches for students. Less intrusive approaches might be teacher and peer models and direct manipulation of "math" materials; the emphasis of stimuli salient to student; the discovery of (through ecological inventory) and application of math concepts to priority material for a given student (Standard 3, p. 199). (Martha Snell, University of Virginia)

> The use of portfolio and/or performance assessment to appraise performance relative to the *Standards* should make including students with disabilities as feasible as including students without disabilities. The use of portfolio speaks to different disability categories and degree of disability severity in the same manner that it speaks to other needs students might bring to the classroom setting. Certainly teachers who have worked with students with disabilities have in some cases more experience working with this type of assessment than do teachers of "typical" students. Some of the same types of decisions used in designing a program for a student with special needs are used in designing alternative assessment. In my experience, I have found that special education teachers have been more willing to look at alternative assessment processes. For many teachers, using portfolio and/or performance assessment should remove some of the problems they see in including a wide diversity of students in any one class. (Pat Tinto, Syracuse University)

Yet, some respondents who supported alternative assessments mentioned specific concerns about accommodations in testing for students with disabilities. For example:

> The use of performance and portfolio assessments is an excellent idea. If correctly managed and verified I would argue that they serve as substitutes for measuring a student's proficiency in mathematics. With regard to different disability categories and degrees of disability: Each student should have the opportunity to meet the NCTM *Standards*. Assessment and instructional accommodations should be, must be, made with particular students (e.g., visually impaired). Students with mental disability will only be able to meet some of the *Standards*, others none. These determinations should be made by the child study team and alternative programs instituted. (Stanley Vitello, Rutgers-The State University of New Jersey)

Other experts who responded to the survey were still uncertain about the idea of the alternative procedures.

> What, for example, do you mean by a performance assessment? Do you mean that a student could show you (with sticks, for example) how to do subtraction in a way that does not require borrowing so as to get the idea of world class standards? Or, do you mean rote response with materials. Do you mean, for example, that a student given a word problem would be required to actually do it? I am not certain what is meant by portfolio assessment. We see the matter as one of portfolio management, for the assessment part of it has not seemed to change as yet. Until the components of the portfolio become qualitative and truly give us better information, portfolios are wasted. (John Cawley, SUNY at Buffalo)

> If feasibility is the primary criterion for determining inclusion of students with disabilities in performance appraisals related to the NCTM *Standards*, then the use of alternative assessment procedures may not be feasible. Alternative forms of assessment (e.g., dynamic assessment, instructional assessment) require highly trained personnel and substantial amounts of time. However, at this point, it's difficult to make this determination with any smarts, because we simply don't know the "costs and benefits" associated with the range of alternative measures. (Edward Kameenui, University of Oregon)

How useful are the NCTM *Standards* in guiding assessment with respect to students with disabilities? (In your answer, please distinguish between program assessment and individual assessment.)

Nine of the eleven experts responded to this issue. Most respondents seemed to agree that the *Standards* need more specification and that utility is tied to classroom teachers' adoptions.

> Good general guides and the recognition of some approaches already used in special education but more specification seems clearly needed for meaningful individual assessment. Perhaps, the use of case study examples not for teachers to imitate and directly apply but to teach teachers a test-teach-test cycle and to illustrate possibilities. What is given [in the *Standards*] about individual assessment is exciting (i.e., pp. 199-204). Many ideas for assessment of individuals are highly appropriate. The focus is an "equity for all students" using student behavior observation as the vehicle for assessment and active "behaving" as the vehicle for teaching. (Martha Snell, University of Virginia)

> I don't think the *Standards* intended to address each group of students (low, middle, high) separately, so it is impossible to say that the *Standards* apply to all groups equally. The *Standards* can be a guide, but it will remain the teachers' judgment as to what aspects are covered, emphasized, and so on. (a math education professor)

> The *Standards* are very useful as a criterion for program assessment for students with disabilities. The *Standards* are written for all students and thus serve as a guide for mathematics programs for all students. The "program expectation and support" spoken to in Evaluation standard 11 should play a key role in bringing mathematics programs for students with disabilities into alignment with the *Standards*. Similarly, addressing opportunities to learn, and instructional resources and classroom climate as part of instruction consistent with the *Standards* should speak to students with disabilities. Equal access is a component of a mathematics program that meets the *Standards*. Thus, the mathematics program of a school should be evaluated with respect to the *Standards* and to all students including those with disabilities. The *Standards* are also useful in guiding individual assessment. They allow a student with disabilities (and those without) to be assessed on what they know and how they think. Assessment instruments must vary and focus on a range of tasks and allow for diversity in student responses. The discussion on assessing mathematical concepts in the *Standards* notes the developmental nature of concept acquisition and the importance of time. This discussion is very useful in guiding assessment of students with disabilities. (Pat Tinto, Syracuse University)

> The *Standards* clearly show a connection between the purpose, method, type and client. They differentiate between program assessment and individual assessment. What is probably different is how the *Standards* are grade level referenced which makes sense since the curriculum is so nicely divided along these. (Brian Enright, University of North Carolina-Charlotte)

> In individual assessment, the *Standards* are rich with potential examples for portfolio and other project related measures of student performance. They will require reflective teaching, that is, teachers must themselves problem-solve and

> work collaboratively with students to identify, select, and monitor learning outcomes. (Luanna Meyer, Syracuse University)

Others questioned the usefulness of the *Standards* in assessment of students with disabilities, on more sweeping grounds.

> I do not believe the *Standards* are of any use in guiding assessment without program and individual goals. What is it you want to assess? Even the constructivists have not worked out a system of assessment yet. (John Cawley, SUNY at Buffalo)

> The *Standards* are too vague to guide assessment. (a special education professor specializing in math education)

> The *Standards* are useful only because they presently serve as the mainstream framework of what is happening in general education mathematics. If they weren't being . . . endorsed, then the *Standards* would not be useful. (Edward Kameenui, University of Oregon)

> Actually, I think the *Standards* are quite useless for guiding assessment with respect to students with disabilities. It is difficult to see in the *Standards* where the issue of students with disabilities is seriously addressed. Although they refer to students of all abilities in a generic sense, the use of the *Standards* for special education students is pretty much ignored and will probably have little impact on assessment for these students. (Ted Hasselbring, Vanderbilt University)

Should the *Standards* be altered in any way for different disability categories or for different degrees of disability severity? If "yes," please explain.

Ten experts responded to this question. Six experts in special education were clear that the *Standards* should be changed for different disabilities. More specifications were the most frequently mentioned change.

> I think the *Standards* as they are written are only appropriate for students with mild learning problems, mild emotional problems, hearing impairments, and perhaps visual impairments. I have difficulty seeing how the *Standards* are appropriate for students with more severe disabilities. I do think, however, that the idea of developing deeper understanding, with less focus on procedural knowledge, is appropriate no matter what the severity of the disability. (Ted Hasselbring, Vanderbilt University)

> Instructional methods should be completely removed and placed in the '91 Professional *Standards*. Curriculum coverage should be evaluated for more severe populations and priorities identified. The same should be done for the mild population with the grade 9-12 *Standards*. (a special education professor)

> Again, we have the problem of goals and individual needs and talents. Clearly, the 9-12 curriculum components of the *Standards* are not going to be in line with the developmental capabilities of many students with disabilities. (John Cawley, SUNY at Buffalo)

Others, including two math education experts, rejected the notion that the *Standards* should be altered for different disabilities. For example:

> I would expect that the *Standards* should not be altered, but that we should make an honest effort to determine which areas and to what level of achievement the *Standards* fit the needs of our students. A severely intellectually impaired individual probably does not need all areas of math but an intense grounding in life skill related math. What we should not do (and I see this frequently) is to drill basic without any relevant relationship of these skills to life and application. (Brian Enright, University of North Carolina-Charlotte)

> No. I do think that a separate document may be useful for teachers who work with learning disabled students. I wouldn't want it in the *Standards* though because it may increase the tendency of a teacher to start to label particular students by what they can't do, rather than by what they can do. (a math education professor)

Finally, some respondents discouraged large scale alteration of the *Standards*, but proposed that their utility could be enhanced with more suggested uses and procedural detail.

> This is an important question. As a principle the answer should be "NO" because the presumption and practice would soon become that students with disabilities (e.g., learning disabled) cannot achieve the more advanced standards, thereby underestimating the capacity of a number of students. On the other hand, one needs to be realistic. From what we know, it is unrealistic to expect that a student with severe mental retardation will be able to grasp trigonometry. Therefore, for this student the sequence of mathematical learning will be truncated, K-4 concepts/learning overlearned, enriched and frequently applied to living and work situations. In short, students whose mental capacity limits their intellectual/quantitative growth should be exempted from the requirement to satisfy the NCTM *Standards* with an appropriate IEP in place. (Stanley Vitello, Rutgers-The State University of New Jersey)

> I don't want to advocate that more detail be added in assessment and teaching (methods or content) by specific disability area (LD, ED, EMR, etc.). This would contradict much of the philosophy I admire. Perhaps instead the *Standards* need more procedural detail for individual assessment and instruction for "challenging" students (mild disabilities and at risk) and guidelines for short-cutting, emphasizing functional area, improving application, for students whose focus will be in K-4 and 5-8 (more extensive cognitive or severe disabilities). (Martha Snell, University of Virginia)

Discussion

Despite the limitations of using a nonrandom and intentional sample, the opinions of "experts" in the field of mathematics education or/and special education provide important information about the NCTM *Standards* and math education for students with disabilities. The

identified experts for the current survey were individuals who played key roles in both research and teacher training in the fields of mathematics and/or special education.

Although there was some variation in familiarity with the *Standards* among the experts, they tended to have similar views of math education in relation to the *Standards*. In comparing the acceptance of the NCTM *Standards* with present practice in math education, the opinions of these experts closely matched the results of the recent teacher survey conducted by Horizon Research (1992). That survey elicited responses from 786 elementary, middle, and high school teachers from 200 schools (selected as a representative sample). The Horizon Research survey indicated that many teachers do not adopt the NCTM *Standards* successfully, despite wide acceptance at the school administration or system level. Furthermore, the low correspondence between the current math education program and the *Standards* pointed out by the current respondents was similar to the Horizon Research finding that math classes continue to overemphasize drill and computation. Current math education in both general and special education is far from the "ideal" proposed by the NCTM *Standards*.

Experts participating in the present survey exhibited two basic points of consensus about math education and the *Standards*: (1) there has been minimal adoption of the *Standards*, and (2) math education continues its overemphasis on basic skills. In contrast to this consensus, was a clear difference in predictions about the direction of the future adoption of the *Standards* in practice. This schism seems to be related to different perspectives (optimistic or skeptical) on the implementation of the *Standards* in math education. Some experts regard the current problematic situation as a starting point from which the visions of the *Standards* "ensure quality, indicate goals, and promote change" in math education, even for the students with disabilities (p. 2). Others believe that the NCTM *Standards* are too vague and ambiguous to be a guideline for the curriculum and evaluation of math education for students with disabilities. The different perceptions of the usefulness of the *Standards* are like the glass of liquid that is viewed as "half-full" by some and "half-empty by others.

The same disagreements were reflected in the experts' ratings of appropriateness (the degree to which the *Standards* should be addressed) and feasibility (the overall likelihood that the *Standards* can be adequately addressed) in relation to students with disabilities across grade levels (Shriner, Kim, Thurlow, & Ysseldyke, 1992). Most of the experts responding to the current survey were in agreement that the *Standards* should be addressed through curriculum and evaluation in elementary level math education (grades K-4). Agreement was considerably lower beyond the elementary grades and in ratings of the feasibility of the *Standards*.

This bipolar perception of the *Standards* was quite evident in the current survey. Respondents who had generally favorable opinions about the *Standards*, pointed out the inappropriateness of current math education practice for students with disabilities and called for changes in line with the visions of the *Standards*. They suggested non-substantial alteration of the *Standards* for different disability categories or for different degrees of disability severity. In contrast, some experts were concerned about what they consider to be inevitable limitations of the *Standards* in relation to special education practices they considered quite appropriate. In this viewpoint, appreciation of the importance of individual differences is pitted against a "one size fits all mentality" (Carnine, 1992). The distinction between nomothetic and idiographic approaches is an age-old dilemma in special education as well as in other fields (Fuchs & Fuchs, 1990; Valsiner, 1986). Some see the *Standards* as a generalized nomothetic ideal, a view sometimes criticized as being less appropriate and less sensitive for the unique and nonrecurrent student encountered in special education practice. These criticisms can be summarized in terms of two considerations.

First, a generalized vision or consensus from a professional organization does not guarantee effectiveness. Carnine (1992), as well as some experts included in the current survey, asserted that the educational establishment should rely on a growing body of scientific knowledge based on carefully implemented research, rather than on consensus. In the case of the *Standards*, the generalized vision encounters problems because it must be applied to a particular student, setting, and teacher. The knowledge base in education should be extensively tested.

However, as Carnine pointed out, the recommendations of the NCTM *Standards* have never been "systematically investigated in any school" (p. 8).

Second, the *Standards* need more specification. This point was made by most of the experts in the current survey. The *Standards* provide only the general statements that can used to judge the quality of a math curriculum or methods of evaluation (National Council of Teachers of Mathematics, 1989, p. 2). Some of the experts were concerned about the lack of explanatory or illustrative materials. It was believed that without adequate training or support for teachers the sole document will make little difference in the education of students with or without disabilities.

NCTM already has begun to address these concerns. The Addenda Project is producing materials "to provide teachers with classroom ideas for translating the standards into practice" (Zawojewski, 1991, p. iv). These materials are collectively known as the Addenda Series, and include booklets for each grade level (K-6) and for specific topic areas for grades 5-12. The "unifying themes" of the *Standards*, problem solving, communication, reasoning, and connectedness, are stressed throughout. Examples of activities are provided with the intention of illustrating how "the vision could be realistically implemented in the K-12 classroom" (p. iv).

The inclusion of children who historically have been less successful in school (students with disabilities) remains an important concern. In a precedent form of the *Standards*, the NCTM presented a set of recommendations for school mathematics in the 1980s, called "An Agenda for Action" (National Council of Teachers of Mathematics, 1980). At that time, the NCTM conducted a survey of the Priorities in School Mathematics Project (National Council of Teachers of Mathematics, 1981) involving various interest groups (teachers, teacher trainers, administrators, and parents). The survey was designed to collect information on beliefs and reactions to possible math curriculum changes. In this survey report (National Council of Teachers of Mathematics, 1981) comments were made about the importance of inclusion of students with disabilities in decision making relative to future developmental activities:

> The needs of students with mathematics learning problems and other handicaps should have priority over the needs of four other types of students (urban, second language, female, and ethnic minority), according to all survey samples. Many (45%) felt

> that this type of student has special needs that should be addressed through the curriculum. (p. 25, emphasis added)

This statement clearly indicates the recognized needs of students with disabilities and suggests an avenue by which these needs could be addressed (curriculum development). Yet, the 1989 *Standards* do not reflect these recommendations, and although they are intended to be "appropriate for all students" (p. 8), it is hard to see where the attention has been directed. How can this gap between NCTM's previous recommendations and the current status of the *Standards* be at least partially bridged? Several possibilities are presented below.

First, the intended uses of the *Standards* need to be clarified for general and special educators. If the *Standards* are maintained as a "vision," then much more development of how to reach the vision is needed. (The Addenda Series is a start, but is not detailed enough to be a plan for instruction.) If the *Standards* are really a prescription for teaching, then validation of the proposed methods is necessary (cf. Carnine, 1992). Currently, scant data exist to support the established standards, and the concern that they are focused on students who can "make it" (Lipp, 1991) is at odds with the zero-reject philosophy held by special education.

Second, the *Curriculum and Evaluation Standards* must be recognized for what they are -- an example of student standards in one subject area (National Council on Education Standards and Testing, 1992). NCEST proposed that student standards include specification of the content of schooling (what students know) and the level of performance that students are expected to attain (how good is enough). The NCTM *Standards* do not say that all students should meet a certain criterion level, although many people seem to think that they do. Rather, the *Standards* say that all students should be exposed to certain kinds of math education. It is up to the teacher to determine what level of achievement is appropriate.

Third, the *Standards* should not be translated into an incentive or accountability system. The potential for unfair or, perhaps, punitive effects is significant, especially for students with disabilities or who are at risk. Although the authors of the *Standards* contend that "the mathematical content outlined in the *Standards* is what all students will need if they are to be productive citizens" (p. 9), they did provide a two-stage curriculum. For example, 11 out of 14

standards for grades 9-12 are broken down according to students' needs (all students can . . . . ; college-intending student can . . . .). The *Standards* will be more desirable if they are realistic and flexible; attaching unneeded school or system level pressures to meet them will not help any student become a better citizen. Further articulation of how they might be applicable to different learners would be welcomed.

With high expectations, a set of dynamic standards could guide math education for students with disabilities toward excellence in a realistic way. The results of the current survey suggest, however, that the difficulties of the task cannot be resolved easily. A unified effort to develop a relevant knowledge base in math and special education can help to bridge the gap that currently exits between vision and practice. In addition, concentrated efforts need to be made to keep researchers and practitioners informed of the knowledge base. This activity will be especially important as the NCTM *Standards* are used by states and schools to reshape their curricula. Other groups that are setting standards may learn a great deal by closely examining the success and perils encountered as rhetoric is translated into instructional practice.

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